

REMARKS

Claims 29-32, 34-39, 41, 44-47, 49 and 51-64 are pending in this application. Claims 44 and 59 have been amended. No new matter has been introduced.

Claims 29-32, 34-35, 44-47, 49 and 51-64 stand rejected under 35 U.S.C. § 102 as being anticipated by Xing et al. (U.S. Patent No. 6,090,697) ("Xing"). This rejection is respectfully traversed.

The claimed invention relates to an electropolished patterned metal layer formed as part of a semiconductor device. As such, independent claim 29 recites a semiconductor device comprising *inter alia* "an insulating layer provided over said substrate" and "an electropolished patterned metal layer provided within an opening of said insulating layer." Independent claim 29 also recites that "a top surface of said electropolished metal layer is . . . at the same level with a top surface of said insulating layer." Independent claim 29 further recites "a photoresist plug provided within said opening and over and in contact with said electropolished patterned metal layer."

Amended independent claim 44 recites a "processor-based system" comprising *inter alia* "a container capacitor including a lower electrode and an upper electrode," the lower electrode "comprising an electropolished patterned metal layer having a thickness of approximately 50 to 300 Angstroms." Amended independent claim 44 also recites that "a top surface of said electropolished patterned metal layer is at the same level with a top surface of said insulating layer." Amended independent claim 44 further recites that the upper electrode comprises "doped polysilicon."

Independent claim 55 recites a "container capacitor" comprising *inter alia* "a lower electrode provided within a first insulating layer, said lower electrode comprising an electropolished patterned metal layer having a bottom wall and vertical

sidewalls extending rectangularly upwardly therefrom.” Independent claim 55 further recites “a second insulating layer provided over said electropolished patterned metal layer and in contact with said first insulating layer” and “an upper electrode provided over said second insulating layer.”

Amended independent claim 59 recites a “container capacitor” comprising *inter alia* “a tantalum nitride barrier conductive layer” and “a lower electrode . . . comprising an electropolished patterned metal layer.” Amended independent claim 59 also recites that the electropolished patterned metal layer has “a bottom and vertical sidewalls extending upwardly from said bottom, said lower electrode having a thickness of approximately 100 Angstroms.” Amended independent claim 59 further recites “a dielectric material provided over said electropolished patterned metal layer and in contact with said insulating layer” and “an upper electrode comprising doped polysilicon provided over said dielectric material.”

Independent claim 60 recites a “container capacitor” comprising *inter alia* “a plurality of rectangular openings provided in said insulating layer” and “a plurality of lower capacitor electrodes provided along the bottom and sidewalls of respective ones of said rectangular openings, said lower electrodes being formed as discrete electropolished metal layers.” Independent claim 60 also recites “a dielectric layer associated with each of said discrete lower electrodes, said dielectric layer being in contact with said insulating layer.”

Xing relates to a “high-selectivity via etching process” that “includes the steps of: forming an etchstop layer 840 of a material selected from the group consisting of Ti--Al, Ti--Al--N, Ta--Al, Al--N, Ti--Al/Ti--N, Ti--Al--N/Ti--N, Ta--Al/Ti--N, and Ti--Al/Ti--Al--N; forming a dielectric layer over the etchstop layer; and etching the dielectric layer with a fluorine-bearing etchant.” (Abstract).

Applicant reaffirms that the limitation “electropolished patterned metal layer” is simply not a product-by-process limitation, but rather a *resulting structure* having distinct and defined characteristics. The term “electropolished patterned” describes the physical characteristics of the metal layer in independent claims 29, 44, 55, 59 and 60. Specifically, the term “electropolished patterned” is a limitation of the metal layer. Claim limitations which confer distinct and defined characteristics of a structure have been analyzed by the Federal Circuit in Hazani v. U.S. Int’l Trade Comm’n, for example. Hazani v. U.S. Int’l Trade Comm’n, 126 F.3d 1473, 44 USPQ2d 1358 (Fed. Cir. 1997). An “electropolished patterned metal layer,” like the “chemically engraved” plate of Hazani, is a *resulting structure* having distinct and defined characteristics and not a product formed by a particular process. See also MPEP §2113 citing In re Garnero, 412 F.2d 276, 279, 162 USPQ 221, 223 (CCPA 1979) (holding that “interbonded by diffusion” was a structural limitation, and further holding that terms such as “welded,” “intermixed,” “ground in place,” “press fitted” and “etched” can be considered structural limitations). Thus, this is a first reason why Xing fails to anticipate the subject matter of claims 29-32, 34-35, 44-47, 49 and 51-64.

Xing fails to disclose “an electropolished patterned metal layer provided within an opening of said insulating layer” and “a photoresist plug provided within said opening and over and in contact with said electropolished patterned metal layer,” as independent claim 29 recites. Xing teaches the formation of bottom capacitor electrode 304, which would arguably correspond to the “electropolished patterned metal layer” of the claimed invention, by conventional methods and not by electropolishing with “a photoresist plug provided within said opening and over and in contact with said electropolished patterned metal layer,” as in the claimed invention. Regarding the limitation “a photoresist plug provided within said opening and over and in contact with said electropolished patterned metal layer,” Applicant is not aware

of any case law or MPEP provision that preclude Applicant to claim an intermediate structure. The fact that the “photoresist plug” may be subsequently removed, does not preclude claiming such structure.

Xing also fails to disclose a “processor-based system,” much less a “processor-based system” comprising *inter alia* “a container capacitor. . . comprising an electropolished patterned metal layer having a thickness of approximately 50 to 300 Angstroms,” as amended independent claim 44 recites. Xing is also silent about an upper electrode “comprising doped polysilicon,” as amended independent claim 44 further recites. Xing teaches that the top electrode “is preferably platinum” and not “comprising doped polysilicon,” as in the claimed invention.

Xing is further silent about “a lower electrode . . . comprising an electropolished patterned metal layer having a bottom wall and vertical sidewalls extending rectangularly upwardly therefrom,” as independent claim 55 recites. Applicant notes that it is the capacitor illustrated in Figure 3 of Xing that would arguably correspond to the capacitor of the claimed invention. The capacitor illustrated in Figure 5 of Xing does not correspond to the capacitor of the claimed invention, as the Office Action mistakenly asserts. Applicant submits that Xing clearly teaches that “FIG. 5 illustrates a fourth preferred embodiment crown cell capacitor . . . similar to that of FIG. 2.” (Col. 6, lines 51-52). The capacitor illustrated in Figure 2 of Xing, however, has a configuration and characteristics completely different from those of the capacitor of the claimed invention. Accordingly, it is the capacitor illustrated in Figure 3 of Xing (and not that illustrated in Figures 5 or 2 of Xing) that would arguably correspond to the capacitor of the claimed invention. Capacitor electrode 304 of Figure 3 of Xing has vertical sidewalls that form an obtuse angle with the bottom of the capacitor and do not extend “rectangularly upwardly therefrom,” as in the claimed invention.

Xing is also silent about a “container capacitor” comprising “a tantalum nitride barrier conductive layer provided at a bottom of said opening” (claim 59), or about “a plurality of rectangular openings provided in [an] insulating layer,” much less about “a plurality of lower capacitor electrodes provided along the bottom and sidewalls of respective ones of said rectangular openings” (claim 60). Applicant notes that adhesion layer 310 of Xing, which would arguably correspond to the “tantalum nitride barrier conductive layer” of the claimed invention, is formed of a variety of materials which do not include “tantalum nitride.” Applicant further submits that layer 208/308 of Xing does not correspond to the “tantalum nitride barrier conductive layer provided at a bottom of said opening” of the claimed invention, as the Office Action mistakenly asserts.

Xing also fails to disclose “an electropolished patterned metal layer” or “electropolished patterned metal layers,” much less “an electropolished patterned metal layer” or “electropolished patterned metal layers” as part of capacitor structures, as in the claimed invention. As noted above, the limitation “electropolished patterned metal layer” of independent claims 29, 44, 55, 59 and 60 is not a product-by-process limitation, but rather a *resulting structure* having distinct and defined characteristics. For at least these reasons, Xing fails to anticipate the claimed invention, and withdrawal of the rejection of claims 29-32, 34-39, 41, 44-47, 49 and 51-64 is respectfully requested.

Claims 36-39 and 41 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Xing in view of Huang (U.S. Patent No. 6,127,260) (“Huang”). This rejection is respectfully traversed.

Independent claim 36 recites a “memory cell” comprising *inter alia* “a transistor including a gate fabricated on a semiconductor substrate” and “an

electropolished patterned metal layer within an insulating layer provided over said substrate, said electropolished patterned metal layer having a thickness of about 50 to about 300 Angstroms." Independent claim 36 also recites "a container capacitor including a lower electrode, a dielectric layer over said lower electrode, and an upper electrode over said dielectric layer, said upper electrode comprising doped polysilicon." Independent claim 36 further recites that the electropolished patterned metal layer forms the lower electrode.

Huang teaches a method of forming a "tee shaped tungsten plug." (Title). Huang teaches that the "process allows the aspect ratio for a narrow diameter opening, to be reduced, by utilizing a two stage opening procedure." (Abstract). According to Huang, "[a] first stage is used to create a first narrow diameter opening, in composite insulator layers, via an anisotropic RIE procedure" and "[a]n isotropic wet etch procedure is then employed to widen the first narrow diameter opening, only in an overlying, doped silicon oxide component of the composite insulator layers, while the openings in the underlying, undoped silicon oxide components, of the composite insulator layers, do not increase in diameter." (Abstract).

The subject matter of claims 36-39 and 41 would not have been obvious over Xing in view of Huang. Specifically, the Office Action fails to establish a *prima facie* case of obviousness. Courts have generally recognized that a showing of a *prima facie* case of obviousness necessitates three requirements: (i) some suggestion or motivation, either in the references themselves or in the knowledge of a person of ordinary skill in the art, to modify the reference or combine the reference teachings; (ii) a reasonable expectation of success; and (iii) the prior art references must teach or suggest all claim limitations. See e.g., In re Dembiczak, 175 F.3d 994 (Fed. Cir. 1999); In re Rouffet, 149 F.3d 1350,

1355 (Fed. Cir. 1998); Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc., 75 F.3d 1568, 1573 (Fed. Cir. 1996).

First, not all limitations of independent claim 36 are disclosed, taught or suggested by the prior art references, whether considered alone or in combination. None of Xing and Huang, considered alone or in combination, discloses, teaches or suggests a “memory cell,” much less a “memory cell” comprising *inter alia* “a transistor including a gate fabricated on a semiconductor substrate” and “an electropolished patterned metal layer within an insulating layer provided over said substrate, said electropolished patterned metal layer having a thickness of about 50 to about 300 Angstroms,” as in the claimed invention.

The combined references also fail to disclose, teach or suggest “a container capacitor including a lower electrode, a dielectric layer . . . and an upper electrode . . . comprising doped polysilicon,” as independent claim 36 also recites. Xing teaches that the top electrode “is preferably platinum” and that “[a]lternative materials for the top electrode include . . . Ti--N, Ti--Al--N, Ta--N, Ta--Al--N, W--N, W--Al--N, Cr--N, Cr--Al--N, Ru--N, Ru--Al--N, Mo--N, Mo--Al--N, V--N, V--Al--N, Hf--N, and Hf--Al--N” (col. 5, lines 45-52), and not “comprising doped polysilicon,” as in the claimed invention. Huang teaches the formation of a tee shaped tungsten plug to avoid high aspect ratio contact holes in embedded DRAM devices, and not the formation of “an electropolished patterned metal layer,” much less of “an electropolished patterned metal layer . . . having a thickness of about 50 to about 300 Angstroms” and of “an upper electrode . . . comprising doped polysilicon,” as in the claimed invention.

Second, Applicant notes that a person of ordinary skill in the art would not have been motivated to combine the teachings of Xing with those of Huang to arrive at the claimed invention. To establish a *prima facie* case of obviousness, “[i]t is insufficient

that the prior art disclosed the components of the patented device, either separately or used in other combinations; there must be some teaching, suggestion, or incentive to make the combination made by the inventor.” Northern Telecom, Inc. v. Datapoint Corp., 908 F.2d 931, 934 (Fed. Cir. 1990). This way, “the inquiry is not whether each element existed in the prior art, but whether the prior art made obvious the invention as a whole for which patentability is claimed.” Hartness Int’l, Inc. v. Simplimatic Engineering Co., 819 F.2d 1100, 1108 (Fed. Cir. 1987). Accordingly, a determination of obviousness “must involve more than indiscriminately combining prior art; a motivation or suggestion to combine must exist.” Pro-Mold & Tool Co., 75 F.3d at 1573. This way, a rejection of a claim for obviousness in view of a combination of prior art references must be based on a showing of a suggestion, teaching, or motivation that has to be “clear and particular.” In re Dembiczak, 175 F.3d at 999. Thus, the mere fact that it is possible to find two isolated disclosures which might be combined to produce a new structure does not necessarily render such production obvious, unless the prior art also suggests the desirability of the proposed combination.

The April 6, 2005 Office Action fails to establish a *prima facie* case of obviousness because, as the Court in Northern Telecom, Inc. noted, “[i]t is insufficient that the prior art disclosed the components of the patented device” and there is no “teaching, suggestion, or incentive to make the combination.” Northern Telecom, Inc., 908 F.2d at 934. On one hand, the crux of Xing is a method of “etching a portion of [an] interlevel dielectric layer above [an] etchstop layer plus first conductive layer with an etchant that removes the interlevel dielectric layer at least thirty times faster than the etchstop layer to form a via through the interlevel dielectric layer having a bottom on the etchstop layer.” (Col. 2, lines 22-29). In this manner, “via etch steps involving long overetch, such as when two vias with vastly different depths are etched in the same step, are made possible without etching through the etchstop layer.” (Col. 2, lines 50-

53). On the other hand, the crux of Huang is the formation of a "tee shaped tungsten plug structure" in a "narrow diameter opening, where the aspect ratio of the narrow diameter opening was reduced via a two stage opening procedure." (Abstract).

Accordingly, the only element that Xing and Huang have in common is the substrate on which their respective structures are formed. A person of ordinary skill in the art would also not have been motivated to combine Xing, which teaches removal of an interlevel dielectric layer thirty times faster than that of an etchstop layer, with Huang, which teaches a dual-step process for the formation of a first narrow diameter opening in a composite insulator layer via an isotropic RIE procedure, followed by the formation of a wider diameter opening via an anisotropic wet etch, to allow a tee shaped metal structure to be formed therein. Accordingly, one skilled in the art would not have been motivated to combine these disparate references and, for at least these reasons, the Office Action fails to establish a *prima facie* case of obviousness. Withdrawal of the rejection of claims 36-39 and 41 is respectfully requested.

Allowance of the application is solicited.

Dated: May 11, 2005

Respectfully submitted,

By 

Thomas J. D'Amico

Registration No.: 28,371

Gabriela I. Coman

Registration No.: 50,515

DICKSTEIN SHAPIRO MORIN &
OSHINSKY LLP

2101 L Street NW

Washington, DC 20037-1526

(202) 785-9700

Attorneys for Applicant